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ABSTRACT

A self-paced free recall task was employed to assess the effects of motivational and metacognitive influences on active processing and recall. A total of 81 fourth-graders were randomly assigned to one of four instructional conditions: strategy instructions plus process monitoring instructions; strategy instructions only; process monitoring instructions only; or a practice control group. Strategy instructions consisted of teaching children a cumulative rehearsal fast finish strategy and a less effective individual item repetition strategy. Process monitoring instructions involved talking with the children about the importance of using strategies to help them do their work better or easier and illustrating the principle with a simple, concrete task. It was hypothesized that the instructional manipulation would affect recall and strategy use by altering children's task specific beliefs and metacognitions. Effects of student characteristics and instructional condition were assessed for task-specific attributions and metacognitions, strategy use and recall on the post-test, near transfer, and far transfer tasks. Results indicated that both general and task-specific factors were significantly related to strategy use and recall. Prior to task instructions, motivational factors accounted for the significant variance, whereas following instructions, metacognitive variables increased in importance. (Author/RH)

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Differential Effects of General Metacognition and Task-specific Beliefs on Strategy Use and Recall

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Running Head: Metacognition and Attributions

Paper presented at the Biennial Meeting of the Society for Research in Child Development, April, 1985. Toronto, Ontario, Canada.

Abstract

A self-paced free recall task was employed to assess the effects of motivational (i.e., academic causal attributions) and metacognitive influences on active processing and recall. Eighty fourth graders were randomly assigned to one of four instructional conditions: Strategy plus Process Monitoring Instructions, Strategy Instructions only, Process Monitoring Instructions only, or a Practice Control group. The effects of student characteristics and instructional condition were assessed for task-specific attributions and metacognitions, strategy use and recall on the post-test, near transfer and far transfer tasks. Results indicated that both general and task-specific factors were significantly related to strategy use and recall. Prior to task instructions, motivational factors accounted for the significant variance, whereas following instructions, metacognitive variables increased in importance.

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Differential Effects of General Metacognition and Task-specific Beliefs on Recall Performance

Researchers have investigated various individual differences as explanations for children's failure to maintain or generalize trained strategies. Two of these individual differences are metacognition (Brown, 1978; Cavanaugh & Borkowski, 1979; Flavell, 1979; Paris, 1978; & Schneider, 1983) and motivation (Anderson, 1980; Butkowski & Willows, 1980; Paris & Cross, 1983; Seligman, 1975; Short & Ryan, 1985; & Weiner, 1979). While these factors may influence the maintenance and generalization of trained strategies, a more immediate influence may well be the child's beliefs and perceptions about the specific task (Paris, Newman, & McVey, 1982). The present study investigated the hypothesis that task-specific attributions and metacognitions are more directly related to strategy use and recall than are individual differences in metacognition and motivation.

Since the introduction of the concept of metacognition to developmental psychology, researchers have been searching for the link between metacognition and performance, particularly as applied to metamemory and recall. In 1980, Cavanaugh and Borkowski found only weak and inconsistent relationships. Schneider (1983) conducted a meta analysis on the metamemory recall relationships found in 47 empirical studies. He concluded that the "average quantitative relationship was considerably above what was generally assumed to be the strength of association". Considerable variability in the strength of the relationship occurred, however, depending on how metamemory was assessed and the specific recall tasks employed. Schneider (1983) concluded that memory monitoring (i.e., performance predictions, feelings of knowing, and effort and attention allocation) was more related to strategy acquisition and recall than other types of metamemory. Studies incorporating

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metacognitive components (e.g., feedback, monitoring instructions) into the strategy instructions have further supported the relationship between metacognition and performance (Ringel & Springer, 1980; Lodico et al., 1983), especially for strategy maintenance and generalization.

In an attempt to explain the metacognitive process involved in strategy use, Paris et al (1982) proposed that children's improved performance following strategy instructions incorporating metacognitive components was due to their understanding of the benefit of using the strategy. Metacognitive assessments during the study substantiated their hypothesis. The present study directly assesses the extent to which strategy use and improved recall associated with strategy instructions or general metacognition is due to specific beliefs about the task.

Academic causal attributions is a motivational concept somewhat analogous to metacognition. Both concepts relate to children's beliefs or awareness of tasks and are thought to influence performance (Anderson, 1980; Weiner, 1979; Butkowski & Willows, 1980). In fact, Fabricius and Hagan (1984) assessed strategy knowledge or metamemory, via the causal attributions children made about their recall performance. As with metacognition, attributions have been conceptualized in several ways. Rotter (1969), Connel and Harter (1982) and others have investigated individual differences in children's perceptions of control, and have related aspects of internal versus external orientations to task performance. Other researchers, including Weiner (1979) and Diener and Dweck (1979) have concentrated on assessing and altering children's attributions for their performance on specific tasks.

The self-paced free recall task used by Butterfield et al. (1980) was employed to generate children's task specific metacognitions and attributional beliefs for several reasons. First, Butterfield et al. have shown that children's

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use of an appropriate strategy plus effort (or study time) accounts for a significant proportion of the variance in memory performance. Due to the importance of both strategy and attributions in the present study, it was necessary to utilize a task where both these variables would significantly influence performance. Second, direct measures of strategy use may be derived from analysis of children's pause times while studying each item. for example, if a cumulative rehearsal strategy is being used, pause times increase systematically as compared to equal pause times for individual item rehearsal. Third, several transfer tasks are available where the trained strategy can be applied effectively. In the present study, the strategies were trained with letters as items to remember, and recall of nonsense syllables and a position probe task functioned as transfer tasks.

Instructional strategies were selected in order to enhance students' performance somewhat, yet were not intended to completely obscure initial individual differences between children. In fact, several principles recognized as important for generalization (e.g., quantitative and qualitative feedback) were purposefully omitted so that the influence of both learner characteristics and task instructions on strategy use and recall could be evaluated.

The benefits of strategy training for recall may be derived from providing the learner with a new technique or from changing their beliefs and attributions about the task. In fact, Paris et al. (1982) propose that unless strategy training does effect children's task specific beliefs, the instructional training will have little meaningful effects. The instructional strategy consisted of two component which enabled us to assess the separate effects of simply providing a technique and the added benefits of statements focused on changing children's beliefs about the task.

Strategy and process monitoring instructions were implemented in a two

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by two factorial design. Strategy instructions consisted of teaching children two differentially effective memory strategies (a cumulative rehearsal fast finish strategy and a lesser effective individual item repetition strategy) to facilitate memory. Process monitoring instructions (based on Lodico et al., 1983) involved talking with the children about the importance of using strategies or "special ways" to help them do their work better or easier and illustrating this principle with a simple, concrete task.

Although strategy instructions were expected to improve children's recall following training, the addition of monitoring instructions was expected to enhance children's understanding of the value of using the strategy, and maintain their use of the stratgies in the absence of specific instructions to do so. Therefore, not only was recall hypothesized to improve with strategy plus process monitoring instructions, but task-specific beliefs were predicted to show a corresponding improvement.

The relationship between general and task-specific variables to recall was investigated over the course of task engagement. It was expected that generalized metacognition and attributions would relate more to initial task performance. However, as children become more familar with the task, either through practice or instructions, this general knowledge would become less relevant, whereas, task-specific beliefs would increase in importance.

Finally, the relationship between children's general attributional beliefs and metacognitive knowledge to their task specific beliefs was examined. In accordance with changes in the relative contribution of each to task performance, it was expected that general and task specific beliefs would be relatively more associated prior to task engagement than following it.

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Method

Subjects

Eighty-one fourth graders from Midwest public schools participated in the study. The 65 children who were tested during the fall semester had a mean age of 9.71 while the 16 children tested during the spring semester had a mean age of 10.37.

Children were randomly assigned to one of the four instructional groups, keeping the older and younger children balanced across groups. The Strategy Only, Process Monitoring Only and Control conditions each included 20 children, while the Process Monitoring Plus Strategy condition contained 21.

Materials

General individual differences in metacognition and academic causal attributions were assessed using an adaptation on the Kreutzer, Leonard & Flavell (1975) metamemory battery, and the Mutidimensional Measure of Children's Perceptions of Control (Connell, 1985), respectively. Task specific beliefs about the task were assessed by the attributions children made about their performance, the accuracy with which they predicted their performance, and their instructions to a naive child on how to do the task well.

Academic Causal Attributions. Children's general motivational orientation was assessed using the Multidimensional Measure of Children's Perceptions of Control (MMCPC)(Connell, 1985). This scale consisted of 24 statements about children's perceptions of factors responsible for their successes and failures in school. Children were required to indicate how much they agreed with each statement by circling one of the following responses: very true, sort of true, not very true, not at all true. For each of three dimensions: personal reponsibility, teacher responsibility and causal

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uncertainty, there were four success and four failure statements. The validity of these three subscales was confirmed through factor analysis. The questionnaire was group administered. Each child marked his or her response following the reading of the item aloud by the experimenter. The item was reread if necessary.

Task specific attributions were requested following performance of each of the recall tasks. Children were first required to respond freely to the questions, "Why do you think you were able to do as well as you did?" and "Why do you think you weren't able to remember all of the items?", and then rated the importance of each of five attributional factors in determining the outcome. The five attributions included ability, effort, luck, task difficulty and strategy use. A scale ranging from one (the reason doesn't matter) to five (the reason matters a lot) was presented and the children were instructed to indicate how important they believed each reason was in causing the success or failure.

Metamemory. The general metamemory assessment consisted of the Story List, Preparation Object, Retrieval Event and Rote Paraphrase subtests of the Kreutzer, Leonard & Flavell (1975) battery, as revised by Kurtz and Borkowski (in press). These four subtests assess the child's knowledge of how to use memory strategies to remember information in a variety of situations. These have been determined to be valid and reliable for children of this age (Kurtz & Borkowski, in press). Points for the four subtests were summed for the child's general metememory score.

Task-specific metamemory was assessed during recall using two types of questions, peer tutoring and memory monitoring. Peer tutoring involved having the children explain to a hypothetical third grader how to study the items in order to remember them all. One point was given if a lower order

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strategy was mentioned (e.g., labelling), two points for a higher order strategy (e.g., elaboration or cumulative rehearsal), or three points if the 4/3 circular recall strategy was mentioned. No points were given if the child only repeated task requirements or only relied on effort.

Peformance monitoring for each task involved prediction and estimation accuracy. Before each of the recall tasks the children were asked to predict their performance. Following recall, specific estimates of how well the children thought they did were requested. Prediction and estimation accuracy scores were obtained by taking the absolute value of the actual recall score minus the predicted or estimated value. The child's memory monitoring score for each task consisted of the sum of prediction and estimation accuracy scores for the two trials.

Self-paced Free Recall. This task was modelled after that used by Butterfield et al. (1980). A TRS-80 microcomputer was used to present series of letters sequentially. During training and maintenance each child received the same sequences of randomly selected consonants. The letters Q, X and Z were excluded due to their low frequency of occurrence in everyday usage. V and Y were also excluded due to some children's confusions of these letters during pilot testing. Each letter, starting with the leftmost, remained on the screen until the child pressed a specific key, at which time the next letter in the sequence appeared. Pause time was automatically recorded (to the nearest 25 msec). As soon as the key was pressed following the presentation of the last letter of the sequence a question mark appeared on the screen eliciting recall.

Strategy use was assessed based on Butterfield et al.'s (1980) techniques. First, children's pause times for the seven serial positions was

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standardized individually to a mean of 40 and standard deviation of 10, in order to control for differences in total study time. Next, the sum of the squared distance of each pause from a standardized referent was computed. Two reference pause time patterns were employed: a cumulative rehearsal fast finish and a standard cumulative rehearsal. Reference pause patterns were based on means of five trained adult subjects. Children's strategy use score equalled the lower of the distance from either the cumulative rehearsal fast finish or standard cumulative rehearsal referent.

Procedure

Two pre-test sessions and one session with self-paced recall occurred.

General individual difference assessments. The Multidimensional Measure of Children's Perceptions of Control was administered to all children as a group in their regular classroom during the first session. General metamemory was individually assessed during the second pre-test session.

Self-paced free recall pre-test. Prior to instructions, all children were individually given the self-paced free recall task. It was explained that two sequences of seven letters would appear on the computer screen which the children were supposed to remember. Children could determine when the next letter in the series would appear by pressing the entry key. Prior to each sequence children were asked to predict how many of the letters they would recall and immediately following recall they were asked how many they thought they had remembered. Pause time was automatically recorded. Following the second sequence, specific attributions and metamemory were assessed.

Instructional Manipulation. Children were randomly assigned to one of the four instructional conditions: Process Monitoring Plus Strategy

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instructions, Strategy instructions only, Process Monitoring instructions only or a practice Control group. Pre-test, instructions, the maintenance post-test and transfer tasks occurred during the same individual session. Which transfer task was presented first was blocked.

Process Monitoring Instructions. Prior to strategy instructions, children in the two process monitoring conditions received instructions designed to make them more aware of the value of using strategies to perform tasks. Training consisted of talking with the child about different ways of doing things to make it easier to do them well, and that by paying attention to how well they perform when they use different ways they can determine which way makes the task easier. Children were first given the example of tracing the outline of the United States in order to draw it better and easier. The children actually drew the outline freehand and were then given the opportunity to trace it. Following this, children were asked to think of something special they do to make their work at home or school easier.

Strategy Instructions. Two differentially effective strategies were taught to children in the two strategy conditions. Two recall trials were requested following instructions on each strategy. One-half of the children in each condition received the more effective cumulative rehearsal fast finish strategy first and the other half received the lesser effective individual letter repetition strategy first. Children were requested to repeat the strategy instruction aloud to ensure they understood and were then given one or two practice trials. Following the first recall attempt, positive feedback on strategy use, and prompts to correct any misapplication of the strategy were given. Following strategy instructions, children were asked on which trials (no strategy, less effective strategy and more effective strategy) they had

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remembered the most letters and why. They were then asked to rate the importance of each of the five attributional factors in determining their performance on the best and worst trials. Children in the control group also made four recall attempts and were asked the same evaluative and attributional questions.

Maintenance Post-test. The maintenance post-test consisted of two self-paced recall trials on which the children were told they could study the letters any way they wanted. Recall, pause time and total study time were recorded. In addition, specific attributions and metamemory were assessed, as for the pre-test.

Nonsense Syllable Transfer. For the near transfer task, nonsense syllables were presented as items to remember instead of letters. Two lists of seven nonsense syllables were presented, and the children were instructed to study the syllables any way they wished. All strategy measures, attributions and metamemory were assessed following the two recall attempts.

Position Probe. This task functioned as a far transfer task. Seven trials were given in which the children were supposed to indicate the position in which the probe letter had appeared during presentation. To facilitate response requirements, numbers indicating presentation positions appeared on the screen below the probe letter. The child could indicate the presentation position of the probe letter by saying the number corresponding to the correct position. Pause times were automatically recorded. Following all seven trials, attributions and metamemory were assessed.

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Results

Task specific beliefs

The hypothesis that the instructional manipulation would affect recall and strategy use by altering children's task specific beliefs and metacognitions was tested with two way, monitoring by strategy analysis of variance. Dependent variables consisted of five task-specific attributions (i.e., ability, effort, luck, strategy and task), and two task-specific metacognitive variables: memory monitoring and peer tutoring.

No significant differences in any of the task-specific variables were found for pretest recall. For post-test recall, a marginally significant effect was found for task attributions, $F(3,77) = 2.37$, $p<.1$. Children who received strategy instructions actually attributed more relevance to the ease of the task following training than did children who did not receive strategy instructions ($M = 3.9$ vs $M = 3.5$). A marginally significant effect was also found for post-test memory monitoring, $F(3,77) = 2.61$, $p<.06$. This was due to a significant monitoring by strategy interaction, $F(1,79) = 4.50$, $p<.05$. Children in the monitoring plus strategy condition more accurately estimated their recall than children in the other three conditions ($M=2.43$ vs $M=3.82$).

No significant differences in task-specific attributions or metacognitions were found on either of the transfer tasks.

Strategy use

Children's use of the trained strategy on the pretest, post-test and two transfer tasks was analyzed with monitoring by strategy analyses of variance. No significant effects were found. Inspection of the strategy use scores indicated that children were using a cumulative rehearsal strategy even prior to instructions.

Step-wise regression analyses were used to investigate the relative influence of general versus task-specific attributions and metacognition on

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strategy use. Independent variables entered into the analyses included the four general individual difference variables: causal uncertainty, personal control, and teacher control variables derived from the Multidimensional Measure of Children's Perceptions of Control, as well as the children's score on the metamemory battery; and the seven task-specific variables: attributions to ability, effort, luck, strategy use, and the task, peer tutoring and memory monitoring.

Few of the variables were significantly related to strategy use. On the pretest, 5% of the variance was accounted for by the causal uncertainty variable, the only significant variable to enter into the regression model. 15% of the variance in post-test strategy use was accounted for by children's scores on the peer tutoring variable and personal control, indicating that children who would tell another child to use an effective strategy and who believed in their own ability to influence outcomes also used one themselves. Three variables, accounting for 18% of the variance, were significant predictors of syllable transfer strategy use: general metamemory, teacher control and task-specific effort attributions. For position probe transfer, only 4% of the variance was accounted for by causal uncertainty.

In summary, although both general and task-specific variables were significantly related to strategy use, the proportion of variance accounted for was slight. Although no consistent pattern to the results emerged, it is interesting to note that low causal uncertainty was related to increased strategy usage for the two relatively novel tasks.

Recall

Average recall for the four instructional groups on the pretest, post-test, syllable transfer and probe transfer are presented in Table 1. Results of the two way monitoring x strategy analyses of variance yielded significant effects only on the syllable transfer task. Children who received

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monitoring instructions recalled significantly more of the nonsense syllables than did children who did not receive this component of the instructions, $F(1,79) = 5.59$, $p<.05$.

Results of the step-wise regression analyses for self-paced free recall were more revealing (see Tables 2 through 5). For pretest, post-test and near transfer tasks, general individual differences accounted for the most variance, although the task-specific variables added to the significance of the regression model. It is interesting to note that, on the pretest, only the attributional variables were significant, while on the post-test and transfer tasks, both attributional and metacognitive variables were relevant.

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Discussion

Results of the stepwise regression analyses suggest a greater differentiation over time between metacognition and academic causal attributions than between general and task specific influences. Initially (prior to repeated task engagement) both general and task-specific attributions were significantly related to recall, whereas metacognition was not. Children who believed they could control the outcome of a task, especially using effort and strategies, actually recalled more of the items than did children with less personal control beliefs or who attributed outcomes to the ease or difficulty of the task or to the teacher.

After introduction to the task, however, with either practice or instructions, metacognitive factors increased in relevance to recall over the attributional beliefs. On the posttest, children with greater awareness of their memory processes, for both hypothetical cases and on the specific tasks, recalled more of the consonants. The addition of personal control beliefs, again both general and task specific, significantly improved the children's recall potential.

The relative influence of metacognition to attributions increased even more on the syllable recall and probe recall transfer tasks. General metamemory and memory monitoring maintained their significant relationship on the syllable transfer task, although the general attributional variables did not. In fact, attributions of the specific outcome to effort was the only significant attributional variable associated with recall.

Although the trend from attributions to metacognition was consistent (i.e., all five significant predictors of pretest recall were attributions while three of the four signifcant predictors of syllable transfer were metacognition), the relative importance of general to task specific factors was less explicit. General individual differences were always the first variable

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entered in the step-wise analyses and accounted for the largest percentage of variance (for prestest through syllable transfer), although task specific variables accounted for additional variance on all three tasks.

The influence of metacognition on recall depended on how metacognition was operationalized. Memory monitoring, peer tutoring, general statable metamemory and instructions to monitor one's performance may all be considered aspects of metacognition. However, each of these conceptualizations had a unique contribution on children's recall. It is probable that there is no single individual difference variable related to strategy transfer. In order to elucidate cognitive processes involved in generalization, it may be necessary to consider a combination of metacognitive and motivational variables.

Apparently the minimal instructions given were not sufficient to qualitatively change children's task specific beliefs. The marginal significance of the instructional manipulation, combined with its limited influence, supports this interpretation. Since task specific beliefs did not radically change, general individual differences retained their influence. As the monitoring component of the instructions was included specifically to enhance task specific beliefs, it was surprising more differences did not occur. Further research is needed to delineate the necessary conditions for changes in task specific beliefs.

Although the effects of strategy and monitoring training were weak, posttest results were consistent with the hypothesis of task specific beliefs mediating performance. The two variables marginally affected by the brief training, task attributions and memory monitoring, comprised two of the three task specific variables significantly related to recall on the posttest.

Unfortunately, children who received strategy instructions attributed their recall to the ease of the task to a greater extent than did children who did

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not receive strategy instructions. This difference suggests that children may tend to perceive the strategy as part of the task, rather than as an internal process under their own control. One explanation that has been proposed for the lack of strategy generalization is that the strategy becomes "welded" to the task (Brown, 1978). The attributions of children who received strategy instructions tend to support this theory. This unintentional negative effect of strategy instructions may have attenuated their informational benefit. It is somewhat ironic that while strategy instructions may be providing children with a means to effectively perform a task, it may at the same time be instilling nonfacilitative attributional beliefs about the task. In order to make strategy instructions most effective, it is important to encourage children to see the strategy as an internal, useable process rather than as just part of the task.

Although results of the regression analyses suggested distinct roles for attributions and metacognition across time, correlations between these variables indicated some significant associations. Contrary to expectations, on the pretest general individual differences were relatively unrelated to task specific beliefs. The only significant relationship was between personal control beliefs and memory monitoring. The number of significant associations increased on posttest recall. General metamemory was related to both task specific metamemory variables as well as negatively related to luck attributions. Most of these relationships remained significant during the syllable transfer task, althought not for the probe tranfser. It appears that children were being influenced to a much greater extent by their own abilities and beliefs than they were by the instructions given by the experimenter. This is consistent with the marginal instructional effects on task specific beliefs, and on recall.

Memory monitoring was the only variable significantly related to

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posttest recall and both tranfer tasks. Although this finding is consistent with Schneider's review of metamemory studies (1983), it's interpretation may not be entirely straightforward. In general, research has shown that young children often tend to overestimate their memory ability (Brown, Campione, & Barclay, 1979). Therefore, the greater the recall, the less difference between the children's actual score and their overestimation. Thus, the seemingly accurate monitoring may be no more than closing the gap between children's overly optimistic guesses and their recall. This may be especially true for the probe transfer task. Here children frequently maintained estimates of recall similar to the previous tasks (e.g., "I'll probably get six out of the seven correct"). However, performance was actually much lower (e.g., three or four out of seven), thus inflating the relationship beween memory monitoring and probe tranfer.

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Table 1

Percent average recall and standard deviations on pretest, posttest, syllable transfer and probe transfer tasks

Instructional Condition	Pretest	Posttest	Syllable Transfer	Probe Transfer
Strategy plus Monitoring	69. (19.24)	72. (15.15)	39. (13.65)	50. (21.01)
Process Monitoring Only	73. (10.39)	66. (16.16)	33. (7.93)	42. (23.39)
Strategy Only	63. (12.01)	72. (15.66)	30. (12.51)	47. (21.29)
Practice Control	67. (11.80)	65. (14.19)	31. (8.78)	41. (20.87)

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Table 2

Significant variables in stepwise regression model for pretest recall

Variable	F-value	r^2 = .25
Teacher Control	9.89	
Strategy Attribution	7.02	
Personal Control	5.47	
Effort Attribution	4.83	
Task Attribution	5.29	

Note. Variables were positively correlated, except Task Attribution and Teacher Control

Table 3

Significant variables in stepwise regression model for posttest recall

Variable	F-value	r^2 = .37
Metamemory	16.60	
Memory Monitoring	11.45	
Teacher Control	9.35	
Task Attribution	8.19	
Ability Attribution	7.85	
Causal Uncertainty	7.16	

Note. Variables are positively correlated, except Teacher Control, Task Attribution and Causal Uncertainty

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Table 4

Significant variables in stepwise regression model for syllable transfer

Variable	F-value	$r^2 = .22$
Memory Monitoring	7.44	
Peer Tutoring	6.92	
Metamemory	5.92	
Effort Attribution	5.32	

Note: All variables are positively correlated

Table 5

Significant variables in stepwise regression model for probe transfer

Variable	F-value	$r^2 = .32$
Memory Monitoring	37.86***	

Note: Memory monitoring was positively correlated

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